

# **Canon Paleo Curriculum**

## **Unit 1: The Nature of Science**

### **Introduction to Unit 1**

Scientific Hypothesis  
Observation and Inference  
Qualitative and Quantitative

- 1. Three Hole Bottle Demo-** What is an Hypothesis?
- 2. Scientific Method** -Study Guide for Scientific Method
- 3. Blind men of Indostan Poem-** Background material and poem
- 4. Can You Spot the Scientific Method** - Critical thinking sheet
- 5. Performing an Experiment** – Worksheet
- 6. Observation / Inference** sheet
- 7. Fortune Teller Fish-** Testing an Hypothesis- Setting Up an Experiment
- 8. Quiz** – Observation/Inference
- 9. Qualitative Vs. Quantitative** - Constructing Observation from Inferences
- 10. Cookie Lab** – Using the Scientific Method
- 11. Exam for Unit**

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**Canon Paleo Curriculum**  
**Unit: The Nature of Science**  
**Lesson Plan 1**

**Activity Name: Three Hole Bottle Demo**

**What is a Hypothesis?** (Old answer: Educated guess. New Answer: Best explanation of and observation.) Must be testable and must have a natural explanation.

**Supplies:**

Two empty 64oz. Plastic Pop bottles  
Duct tape  
Awl or glass rod  
Hot plate  
Water  
Activity sheet

**Preparation:**

Heat point of awl on hot plate and poke 3 vertical holes in the side of the bottles  
The holes should be 1 inch apart starting from the center of the bottle  
Cover the holes securely with duct tape  
Fill the bottles to the top, leaving no air space  
Tape the top caps of the bottles if the seal is not secure on the caps

**Concept:**

Students will learn the process of forming a hypothesis and learn how to test it. They will learn how to adjust their initial supposition and determine a natural explanation.

**Activity:**

Pass out activity sheet, The Three Hole Bottle Demo Report  
Follow the steps outlined on the sheet with the class  
Ask the class what their hypothesis is according to step 2 (will it do nothing? will it dribble? will it gush?)  
Uncover the first hole (no water should flow out)  
Step 3 is very important have them record results  
Follow through to step 5 (the water will gush and stop above the second)  
By step 7 the majority of class should have adjusted their hypothesis and reached the sample conclusion, the third hole will gush

Repeat Experiment with the bottle held horizontally and the hole at a 90-degree angle to the floor.

Result is that none of the holes leak (at this angle air can not escape)

**Discussions**

The top hole did not leak, because air needs to fill the space in the absence of water, with no source of air the water will not leak out of the hole. The second and third hole flowed, because the water now has a source of air from the top hole.

**Time:** 20-25 minutes

**Canon Paleo Curriculum**  
**Unit: The Nature of Science**  
**Lesson Plan 2**

**Activity Name: Scientific Method**

**Preparation:**

Copy activity for students to complete

**Activity:**

Pass out activity sheet.

Go over the exercise with the class.

Have them answer the bottom questions.

**Concept:**

Students learn how a scientist sets up a simple hypothesis. Students also learn how to set up control and variable in an experiment and finally how to draw a conclusion.

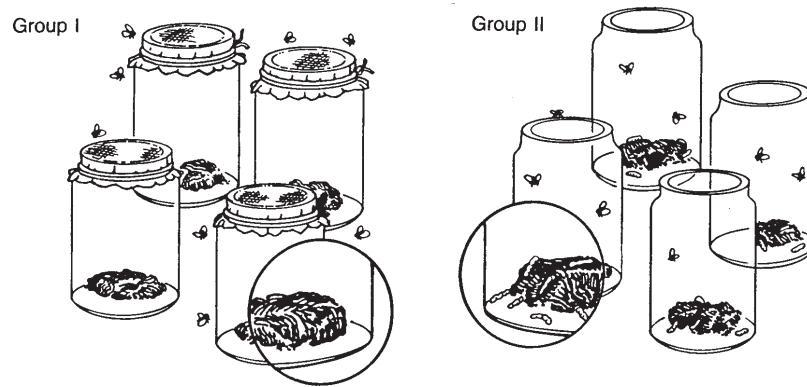
**Discussions:**

Ask students what other kinds of variables might have been tested and have them speculate on conclusions.

**Time:** 25-30 minutes

## Scientific Method

Long ago, many people believed that living things could come from nonliving things. They thought that worms came from wood and that maggots came from decaying meat. This idea was called spontaneous generation. In 1668, an Italian biologist, Francesco Redi, did experiments to prove that maggots did not come from meat. One of his



experiments is shown below.

Redi placed pieces of meat in several jars. He divided the jars into two groups. He covered the first group of jars with fine cloth. He left the second group of jars uncovered. Redi observed the jars for several days. He saw flies on the cloth of the covered jars, and he saw flies laying eggs on the meat in the uncovered jars. Maggots appeared only on the meat in the group of jars left uncovered.

1. Scientists use a series of organized steps called scientific method to solve problems. List the steps that are often used. \_\_\_\_\_

\_\_\_\_\_

2. What was the problem in Redi's experiment? \_\_\_\_\_

3. What do you think his hypothesis was? \_\_\_\_\_

\_\_\_\_\_

4. How did he test his hypothesis? \_\_\_\_\_

\_\_\_\_\_

5. What was the variable in his experiment? \_\_\_\_\_

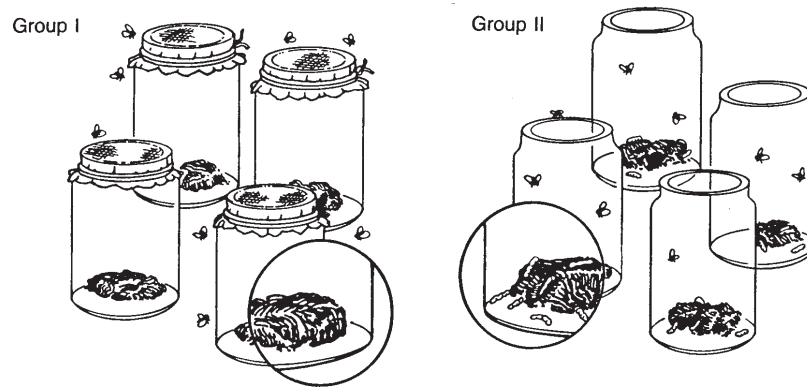
6. What was the control in his experiment? \_\_\_\_\_

7. What do you think Redi's conclusion was.? \_\_\_\_\_

## KEY FOR TEACHERS

### Scientific Method

Long ago, many people believed that living things could come from nonliving things. They thought that worms came from wood and that maggots came from decaying meat. This idea was called spontaneous generation. In 1668, an Italian biologist, Francesco Redi, did experiments to prove that maggots did not come from meat. One of his experiments is shown below.



Redi placed pieces of meat in several jars. He divided the jars into two groups. He covered the first group of jars with fine cloth. He left the second group of jars uncovered. Redi observed the jars for several days. He saw flies on the cloth of the covered jars, and he saw flies laying eggs on the meat in the uncovered jars. Maggots appeared only on the meat in the group of jars left uncovered.

1. Scientists use a series of organized steps called scientific method to solve problems. List the steps that are often used. **identify problem, research, form hypothesis, experiment, conclusion**
2. What was the problem in Redi's experiment? **No maggots come from decaying meat.**
3. What do you think his hypothesis was? **If maggots come from decaying meat, then maggots will appear in covered and uncovered jars.**
4. How did he test his hypothesis? **Experiment with meat in covered and uncovered jars.**
5. What was the variable in his experiment? **covered jar**
6. What was the control in his experiment? **uncovered jar**
7. What do you think Redi's conclusion was.? **Maggots do not come from decaying meat.**

**Canon Paleo Curriculum**  
**Unit: The Nature of Science**  
**Lesson Plan 3**

**Activity Name: Scientific Method Today**

Observation and Inference

**Supplies:**

Use the Six Blind Men poem

**Preparation:**

- Go over definitions of observation and inference with the class before beginning the exercise. Note the background material
- Copy the poem and cut out the six stanzas separately.
- Divide the class into six groups.

**Concept:**

Students will learn the process of developing observations and inferences from data they collect.

**Activity:**

- Have each group find the one observation in the stanza.
- From the one stanza each group has, have them develop an inference about the observation. (such as "What types of animals could they be?")
- Once the group have developed their observations and inference have them join back together as a class.
- Have each group list their observations and inferences on the board.

**Teacher Key:**

After all the observations are listed the group should conclude that it is an elephant.

**Conclusions:**

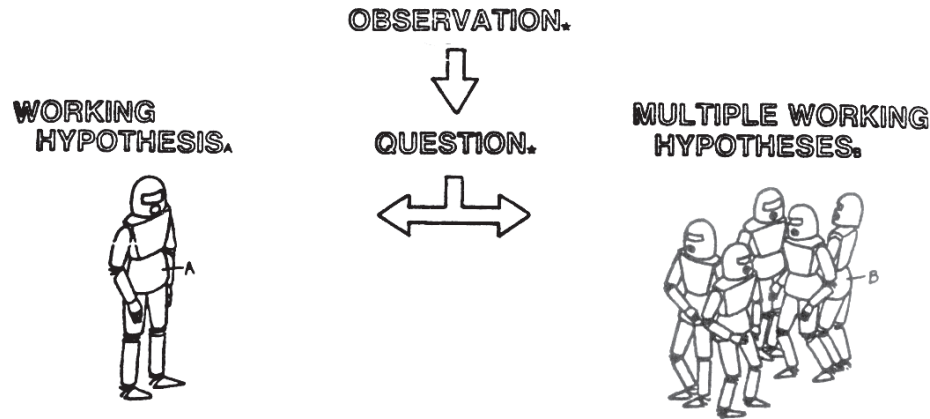
Students should begin to understand not only observation and inference, but the importance of collective data. That research done by many scientists lead to better explanations.

**Time:** 20-25 minutes

## Background Material

Science today still begins with curiosity leading to observation. Almost immediately upon observing something new, a scientist—or any other curious person—will find one or more questions coming to mind.

### SCIENTIFIC METHOD TODAY.



Note the Observation and Question. The robots represent hypotheses.

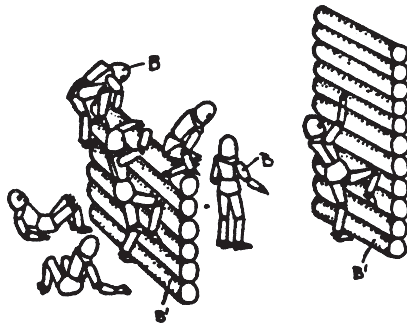
Once a question is raised, an answer is looked for. From Galileo's time onward, scientists have made a habit of regarding every answer as tentative until it has been confirmed by experiment. Such a tentative answer is called a *working hypothesis* (plural: hypotheses), to emphasize that it is still unreliable and is being worked on.

As science progressed, it became clear that even the working hypothesis method had some pitfalls. First, anyone who has an idea that seems to be a good one has a tendency to develop a certain affection for that "brainchild." This can lead to failing to recognize its shortcomings, even when one is trying very hard to be honest. The solution to that shortcoming is the method of *multiple working hypotheses*. In this method there is a deliberate attempt to develop a "family" of hypotheses, and a person is inclined to test and evaluate the hypotheses more honestly.

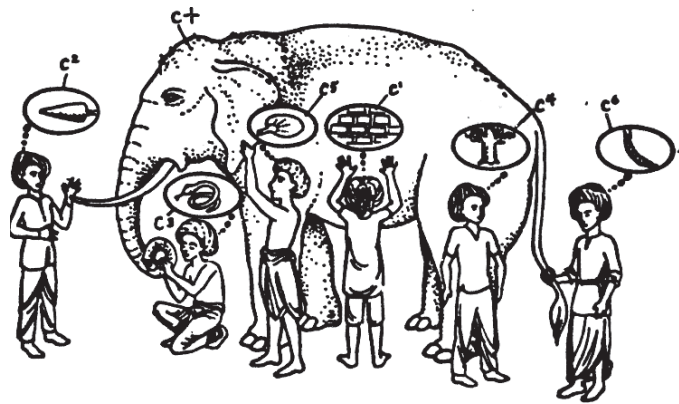
## NONCHALLENGING TEST<sub>1</sub>



## CHALLENGING MULTIPLE TESTS<sub>2</sub>



In these scenes, the hurdles the little hypotheses are jumping over represent tests by experiment. Although it doesn't always happen, it is awfully easy when you are fond of a hypothesis to set up a test that really doesn't challenge it very severely, as illustrated by the rather easy hurdle in the *nonchallenging test* scene. On the other hand, if there are many hypotheses, there is a definite tendency to want to reduce their number, so more tests are designed, and they are usually designed specifically to eliminate hypotheses rather than to support them. When one or more hypotheses survive deliberate attempts to eliminate them, we can begin to have some genuine confidence in them.



REALITY<sub>c+</sub>  
 HYPOTHESIS 1<sub>c</sub>  
 HYPOTHESIS 2<sub>c</sub>  
 HYPOTHESIS 3<sub>c</sub>  
 HYPOTHESIS 4<sub>c</sub>  
 HYPOTHESIS 5<sub>c</sub>  
 HYPOTHESIS 6<sub>c</sub>

This poem was written by John Godfrey Saxe (1816-1887).

This first stanza is left until after students have discovered what type of animal it is:

**Teacher reads this stanza first**

It was six men of Indostan  
 To learning much inclined,  
 Who went to see the animal  
 (Though all of them were blind),

**Stanza 1**

The first approached the animal  
 And happening to fall  
 Against his broad and sturdy side,  
 At one began to bawl:  
 "God bless me! But the animal  
 Is very like a wall!"

**Stanza 2**

The second, Cried, "Ho! What have we here  
 So very round and smooth and sharp?  
 To me 'tis mighty clear  
 This wonder of an animal  
 Is very like a spear!"

**Stanza 3**

The third approached the animal,  
 And happening to take  
 A large tubular part within his hands,  
 Thus boldly up and spake:  
 "I see," quoth he, "the animal  
 is very like a snake."

**Stanza 4**

The fourth reached out an eager hand,  
And felt about the knee,  
“What most this wondrous beast is like  
Is mighty plain,” quoth he:  
“’tis clear enough the animal  
Is very like a tree.”

**Stanza 5**

The fifth, who chanced to touch the ear,  
Said. “even the blindest man  
Can tell what this resembles most:  
Deny the fact who can,  
This marvel of an animal  
Is very like a fan!”

**Stanza 6**

The sixth no sooner had begun  
About the beast to grope,  
Then, seizing on the swinging tail  
That fell within his scope,  
“I see,” quoth he, “the animal  
Is very like a rope.”

**Teacher reads again**

And so these men of Indostan  
Disputed loud and long.  
Each in his own opinion  
Exceeding stiff and strong,  
Though each was partly in the right,  
And all were in the wrong!

**Canon Paleo Curriculum**  
**Unit: The Nature of Science**  
**Lesson Plan: 4**

**Activity Name: Can You Spot The Scientific Method**

**Supplies:**

Worksheet - Can You Spot The Scientific Method

**Preparation:**

Copy worksheet for students

**Concept:**

Students learn to recognize a problem, a hypothesis, a conclusion, and the testing stage of a hypothesis.

**Activity:**

Students complete worksheets on their own.

The class discusses answers

**Conclusions:**

This activity clearly defines the different stages of forming and testing a hypothesis. Students will gain a better knowledge of how to set up their own scientific experiment.

**Time:** 25-30 minutes

## **CAN YOU SPOT THE SCIENTIFIC METHOD CRITICAL THINKING/PROBLEM SOLVING**

**Name** \_\_\_\_\_

**Date** \_\_\_\_\_

**Class** \_\_\_\_\_

Each sentence below describes a step of the scientific method. Match each sentence with a step of the scientific method listed below.

- A. Recognize a problem**
- B. Form a hypothesis**
- C. Test the hypothesis with an experiment**
- D. Draw conclusions**

- \_\_\_\_\_ 1. Stephen predicted that seeds would start to grow faster if an electric current traveled through the soil in which they were planted.
- \_\_\_\_\_ 2. Susan said, "If I fertilize my geranium plants, they will blossom."
- \_\_\_\_\_ 3. Jonathan's data showed that household cockroaches moved away from raw cucumber slices.
- \_\_\_\_\_ 4. Rene grew bacteria from the mouth on special plates in the laboratory. She placed drops of different mouthwashes on bacteria on each plate.
- \_\_\_\_\_ 5. Kathy used a survey to determine how many of her classmates were left-handed and how many were right-handed.
- \_\_\_\_\_ 6. Jose saw bats catching insects after dark. He asked, "How do bats find the insects in the dark?"
- \_\_\_\_\_ 7. Justin wondered if dyes could be taken out of plant leaves, flowers, and stems.
- \_\_\_\_\_ 8. Alice soaked six different kinds of seeds in water for 24 hours. Then she planted the seeds in soil at a depth of 1 cm. She used the same amount of water, light, and heat for each kind of seed.
- \_\_\_\_\_ 9. Bob read about growing plants in water. He wanted to know how plants could grow without soil.

- \_\_\_\_\_ 10. Kevin said, "If I grow five seedlings in red light, I think the plants will grow faster than the five plants grown in white light."
- \_\_\_\_\_ 11. Angela's experiment proved that earthworms move away from light.
- \_\_\_\_\_ 12. Scott said, "If acid rain affects plants in a particular lake, it might affect small animals, such as crayfish, that live in the same water."
- \_\_\_\_\_ 13. Michael fed different diets to three groups of guinea pigs. His experiment showed that guinea pigs need vitamin C and protein in their diets.
- \_\_\_\_\_ 14. Kim's experiment showed that chicken eggshells were stronger when she gave the hen feed, to which extra calcium had been added.

**KEY FOR TEACHERS**  
**CAN YOU SPOT THE SCIENTIFIC METHOD**  
**CRITICAL THINKING/PROBLEM SOLVING**

**Name** \_\_\_\_\_

**Date** \_\_\_\_\_

**Class** \_\_\_\_\_

Each sentence below describes a step of the scientific method. Match each sentence with a step of the scientific method listed below.

- A.** Recognize a problem
- B.** Form a hypothesis
- C.** Test the hypothesis with an experiment
- D.** Draw conclusions

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  B   2. Susan said, "If I fertilize my geranium plants, they will blossom."

  D   3. Jonathan's data showed that household cockroaches moved away from raw cucumber slices.

  C   4. Rene grew bacteria from the mouth on special plates in the laboratory. She placed drops of different mouthwashes on bacteria on each plate.

  C   5. Kathy used a survey to determine how many of her classmates were left-handed and how many were right-handed.

  A   6. Jose saw bats catching insects after dark. He asked, "How do bats find the insects in the dark?"

  A   7. Justin wondered if dyes could be taken out of plant leaves, flowers, and stems.

  C   8. Alice soaked six different kinds of seeds in water for 24 hours. Then she planted the seeds in soil at a depth of 1 cm. She used the same amount of water, light, and heat for each kind of seed.

- A   9. Bob read about growing plants in water. He wanted to know how plants could grow without soil.
- B   10. Kevin said, "If I grow five seedlings in red light, I think the plants will grow faster than the five plants grown in white light."
- D   11. Angela's experiment proved that earthworms move away from light.
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- D   13. Michael fed different diets to three groups of guinea pigs. His experiment showed that guinea pigs need vitamin C and protein in their diets.
- D   14. Kim's experiment showed that chicken eggshells were stronger when she gave the hen feed, to which extra calcium had been added.

**Canon Paleo Curriculum**  
**Unit: The Nature of Science**  
**Lesson Plan 5**

**Activity Name: Performing an Experiment**

**Supplies:**

Worksheet -Performing an experiment

**Preparation:**

Copy worksheet for students

**Concept:**

Students test their understanding of the scientific method. They must discern between hypothesis, problem, observation, conclusion, etc.

**Activity:**

Students complete worksheets on their own.

The class discusses answers

**Conclusions:**

There are gray areas when answering some the questions posed. There are also multiple answers for some of the questions. This should promote a lively discussion and a better understanding of the process of testing a hypothesis. This activity is a good exercise for students before they perform their first experiment.

**Time:** 25-30 Minutes

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

## **Performing an Experiment**

Read the following statements and then answer the questions.

1. A scientist wants to find out why sea water freezes at a lower temperature than fresh water.
2. The scientist goes to the library and reads a number of articles about the physical properties of solutions.
3. The scientist also reads about the composition of sea water.
4. The scientist travels to a nearby beach, and observes the conditions there. The scientist notes the taste of the sea water and other factors such as waves, wind, air-pressure, temperature, and humidity.
5. After considering all this information, the scientist sits at a desk and writes, "My guess is that sea water freezes at a lower temperature than fresh water because sea water has salt in it."
6. The scientist goes back to the laboratory and does the following:
  - a. Fills each of two beakers with 1 liter of fresh water.
  - b. Dissolves 35 grams of table salt in one of the beakers.
  - c. Places both beakers in a refrigerator whose temperature is - 1 degree C.
  - d. Leaves the beakers in the refrigerator for 24 hours.
7. After 24 hours, the scientist examines both beakers and finds the fresh water to be frozen. The salt water is still liquid.
8. The scientist writes in a notebook, "It appears as if salt water freezes at a lower temperature than fresh water does."
9. The scientist continues, "Therefore, I suggest that the reason sea water freezes at a lower temperature is that sea water contains dissolved salts while fresh water does not."

## Questions

- A. Which statements contain *conclusions*? \_\_\_\_\_
- B. Which statements refer to *research*? \_\_\_\_\_
- C. Which statement contains a *hypothesis*? \_\_\_\_\_
- D. Which statements contain *observations*? \_\_\_\_\_
- E. Which statements describe an *experiment*? \_\_\_\_\_
- F. Which statement supports the *hypothesis*? \_\_\_\_\_
- G. In which statement is the *problem* defined? \_\_\_\_\_
- H. Which statement contain *data*? \_\_\_\_\_
- I. Which is the *variable* in the experiment? \_\_\_\_\_
- J. What is the *control* in the experiment? \_\_\_\_\_
- K. Which statement includes an *inference*? \_\_\_\_\_

## KEY FOR TEACHERS

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

### Performing an Experiment

Read the following statements and then answer the questions.

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9. The scientist continues, "Therefore, I suggest that the reason sea water freezes at a lower temperature is that sea water contains dissolved salts while fresh water does not."

## Questions

- A. Which statements contain *conclusions*? \_\_\_\_ 8, 9 \_\_\_\_
- B. Which statements refer to *research*? \_\_\_\_ 2, 3 \_\_\_\_
- C. Which statement contains a *hypothesis*? \_\_\_\_ 5 \_\_\_\_
- D. Which statements contain *observations*? \_\_\_\_ 4, 7 \_\_\_\_
- E. Which statements describe an *experiment*? \_\_\_\_ 6, 7 \_\_\_\_
- F. Which statement supports the *hypothesis*? \_\_\_\_ 7, 8 \_\_\_\_
- G. In which statement is the *problem* defined? \_\_\_\_ 1 \_\_\_\_
- H. Which statement contain *data*? \_\_\_\_ 7 \_\_\_\_
- I. Which is the *variable* in the experiment? \_\_\_\_ SALT \_\_\_\_
- J. What is the *control* in the experiment? \_\_\_\_ FRESHWATER \_\_\_\_
- K. Which statement includes an *inference*? \_\_\_\_ 5 \_\_\_\_

**Canon Paleo Curriculum**  
**Unit: Nature of Science**  
**Lesson Plan: 6**

**Activity Name: Observation and Inference.**

**Keys to the Past**

**Objectives:**

Students will learn what an inference is and differentiate between inference and observation. They will examine a scene and a series of statements about the scene and then determine which statements are observations and which are inferences.

**Background:**

Modern science is based on observation and inference. Observation is seeing and noting facts. Inference is a proposed reason or assumption based on observation. Paleontologists use these two principles to form theories, or put together a picture of what the past was like. By making observations of fossils they can make inferences about the animals or plants they represent. Also, by making observations of modern day plants and animals that are similar to the fossils, they can make inferences about the past.

**Materials:**

Handouts (3) for each student or team:  
Dinosaur scene  
List of statements  
Petrified Bones and Tracks page

**Procedure:**

Discuss the difference between observation and inference then pass out the handouts. Have the students work individually or in teams. They will determine whether each statement is an observation or an inference. Later, go over their answers as a group, discussing the logic used in making their choices.

**Dinosaur Scene:**

A time machine has been invented that travels into the past and takes pictures, sending them to the present. You are asked to look at one of the pictures and interpret what you see. Put an "O" before the statements that are observations and an "I" before the statements that are inferences.

- \_\_\_\_\_ 1. The volcano is erupting.
- \_\_\_\_\_ 2. The camptosaurus is going to eat the stegosaurus.
- \_\_\_\_\_ 3. The stegosaurus will run into the water to escape.
- \_\_\_\_\_ 4. The camptosaurus is leaving tracks in the ground.
- \_\_\_\_\_ 5. The ground where the camptosaurus is walking is wet.
- \_\_\_\_\_ 6. There are plants growing in the water.
- \_\_\_\_\_ 7. The camptosaurus is going into the water to eat the plants.
- \_\_\_\_\_ 8. There is a tree growing next to the river.
- \_\_\_\_\_ 9. The tree looks like a palm tree.
- \_\_\_\_\_ 10. The climate is warm.
- \_\_\_\_\_ 11. The stegosaurus is eating the plant.
- \_\_\_\_\_ 12. The stegosaurus is an herbivore.
- \_\_\_\_\_ 13. There are bones from a dead animal by the shore.
- \_\_\_\_\_ 14. The camptosaurus killed the animal.
- \_\_\_\_\_ 15. Some more bones are in the water.
- \_\_\_\_\_ 16. The camptosaurus can't swim and will drown.
- \_\_\_\_\_ 17. Lava is coming down the sides of the volcano.
- \_\_\_\_\_ 18. The camptosaurus has sharp teeth for eating meat.



Suppose you are a paleontologist and you have just discovered a layer of rock with many fossils in it, both petrified bones and tracks. Decide whether the following statements are observations or inferences.



- \_\_\_\_\_ There are tracks from three different animals in the rock.
- \_\_\_\_\_ One animal was chasing another animal.
- \_\_\_\_\_ Two different animals died in this spot.
- \_\_\_\_\_ When the animals walked here the ground was wet.
- \_\_\_\_\_ One of the animals that died here had bony plates.
- \_\_\_\_\_ One of the animals that died here had sharp teeth.
- \_\_\_\_\_ The animal that had sharp teeth ate meat.

## KEY FOR TEACHERS

### Dinosaur Scene:

A time machine has been invented that travels into the past and takes pictures, sending them to the present. You are asked to look at one of the pictures and interpret what you see. Put an "O" before the statements that are observations and an "I" before the statements that are inferences.

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- ☐ 15. Some more bones are in the water.
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\_\_\_O\_\_\_ There are tracks from three different animals in the rock.

\_\_\_I\_\_\_ One animal was chasing another animal.

\_\_\_O\_\_\_ Two different animals died in this spot.

\_\_\_I\_\_\_ When the animals walked here the ground was wet.

\_\_\_O\_\_\_ One of the animals that died here had bony plates.

\_\_\_O\_\_\_ One of the animals that died here had sharp teeth.

\_\_\_I\_\_\_ The animal that had sharp teeth ate meat.

**Canon Paleo Curriculum**  
**Unit: The Nature of Science**  
**Lesson Plan 7**

**Testing a Hypothesis**  
**Activity Name: Fortune Teller Fish**

**Supplies:**

One cellophane fish from game supplier  
Activity sheets  
Charts for experiment

**Preparation:**

Copy Fish Observation Worksheet  
Copy Setting Up an Experiment Worksheet  
Purchase Fortune-Telling Fish in advance  
Set up heat sources and moisture sources  
Supplies: desk lamp, water pans (hot and cold), rubber gloves, paper towel, petri dishes.

Have students fill out the Fish Observation worksheet. When they have formed an hypothesis have them start their Setting Up an Experiment Worksheet and procede to experiment stations. Have students do control station first.

**Test Stations**

Control station: Fish laying on a paper towel in a dish for 30 seconds and document results

Variable stations, have students choose one or two based on their hypothesis:

Student puts on rubber glove and lays fish in their palm for 30 seconds, measure temperature of palm with glove and document results.

Student puts fish in a dish on top of paper towel soaked in cold water for 30 seconds, measure temperature of towel and document results.

Student puts fish in a dish on top of paper towel soaked in hot water for 30 seconds, measure temperature of towel and document results.

Student puts fish in a dish on top of a dry paper towel under the desk lamp at 14 inches distance for 30 seconds, measure temperature of towel and document results.

**Concept:**

Students will learn observation skills, how to form their individual hypothesis, and how to test the hypothesis. Students will learn to design an experiment. They will set up the VARIABLE, the EXPERIMENTAL GROUP, and the CONTROL group.

**Activity:**

Have the student complete step 1 and step 2 of the worksheet on their own  
Talk about step 3 and 4 and have them write down their testable hypothesis  
Have the class read and discuss 5 and 6  
Have them outline how they will conduct their experiment  
Have them follow their outline  
Conduct their experiments  
Share the results

**Conclusions:**

Go over the **Fish Observation** and **Setting Up an Experiment** Worksheets with the students. Compare their hypothesis with their conclusions.

The fish will curl with heat and moisture.

**Time:** 2 hours

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_



## Fish Observation Sheet

**Supplies:** Fortune Teller Fish (these can be ordered from GTA, Inc., 14650 28th Ave. , Plymouth, MN, 55447 and cost approximately \$7.00 per gross, phone 800-328-1226), ice, hot plate, gooseneck lamp, water source, aluminum foil, saran wrap and any other things that students would like to include in their experiment.

**Procedure:**

1. Remove the red cellophane “Fortune Telling” Fish from the small plastic envelope.

Observations:

Personality:

2. Follow the directions on the back of the package and watch the fish in your hand for at least 30 seconds. Write down your observations and what the envelope says about your personality.

3. One criteria of science is that there is a NATURAL explanation for the observations. This means that we cannot use a “miracle” or other supernatural events to explain the fish’s movements.

4. Share your results with other members of your group and form at least two

Hypothesis 1:

Hypothesis 2:

hypotheses to account for the fish's behavior. In science, it must be a TESTABLE hypothesis. This means that we should be able to design an experiment to see whether or not your hypothesis is valid.

5. The item being tested in the experiment is called the VARIABLE, the untested comparison group is called the CONTROL. A good experimental design will only test one variable at a time.

6. Design a simple experiment that will test your hypothesis. Your experiment should have an EXPERIMENTAL GROUP and a CONTROL GROUP. Explain your experiment below and identify which group is the experimental group and which is the control. List the materials that you will need to conduct your experiment.

**Name** \_\_\_\_\_

**Class** \_\_\_\_\_

**Date** \_\_\_\_\_

## **Setting Up An Experiment**

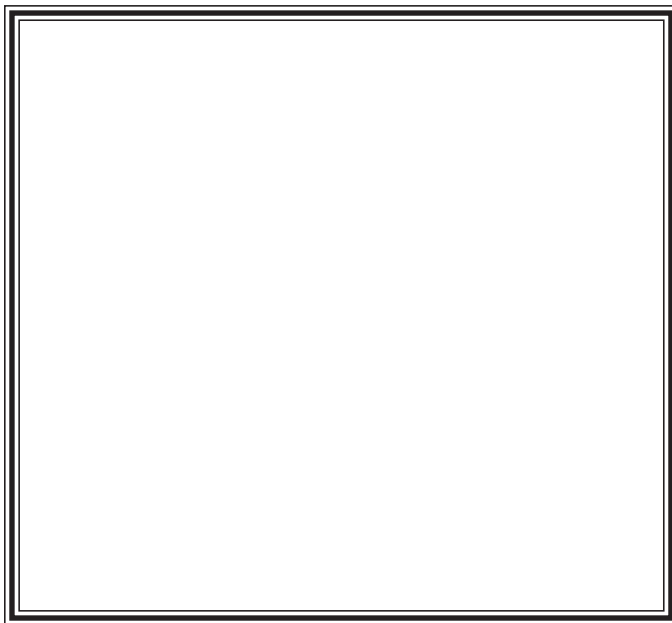
1. Question your exploring: \_\_\_\_\_  
\_\_\_\_\_

2. Idea (hypothesis) you are testing: \_\_\_\_\_  
\_\_\_\_\_

3. What variables will you change in your experiment? \_\_\_\_\_  
\_\_\_\_\_

4. What variables will remain constant in you experiment? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. Make a sketch of the set-up for your experiment. Label all materials and state all conditions. List the materials you need.



**Materials Needed for your experiment:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. During the experiment:

a: What specific things will you observe? \_\_\_\_\_

---

---

---

b: What measurements will you make? \_\_\_\_\_

---

---

c: What plan do you have for recording your data? \_\_\_\_\_

---

---

7. Sketch a sample data table for your experiment:

## **Fortune Telling Fish and Experiment – Key for Teachers**

This lab will vary from group to groups. After lab is complete have class come back together as a group and develop the data collected for the best conclusion. Grades should be based on thorough collection of data and the conclusions reached by individual groups.

The observations and inferences should clearly fit into their defined categories. Hypotheses should be based on these observations and inferences and findings should be supported in their conclusions even if their hypothesis is disproven.

**Canon Paleo Curriculum**  
**Unit: Nature of Science**  
**Lesson Plan: 8**

**Activity Name: Observation and Inference Quiz**

**Supplies:**

Observation and Inference Worksheet

**Preparation:**

Copy worksheet for students

Review definitions of observation and inference

**Concept:**

Students learn to distinguish between observation and inference. Later they will be apply these ideas to their hypothesis.

**Activity:**

Have students fill out worksheet

Reveiw answers

**Conclusions:**

By doing these simple exercises, students begin to think like scientists who are observing the world around us. These exercises help students to develop a more objective way of observing their surroundings.

**Time:** 20-25 Minutes

## Inferences and Observations QUIZ

An observation is anything that can be taken in through the senses. This would be things that you see, hear, taste, smell, touch, or taste. An inference is a statement that explains the observations.

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter "O" for an observation, or the letter "I" for an inference.

1. \_\_\_\_\_ It is summertime.
2. \_\_\_\_\_ It is day time.
3. \_\_\_\_\_ They saw birds.
4. \_\_\_\_\_ They saw seagulls.
5. \_\_\_\_\_ They went swimming.
6. \_\_\_\_\_ One friend's name was Bob.
7. \_\_\_\_\_ It was a warm day.
8. \_\_\_\_\_ The birds were black and white.
9. \_\_\_\_\_ They ate lunch and drank Coke.
10. \_\_\_\_\_ The people are friends.

## Inferences and Observations Quiz - KEY FOR TEACHERS

An observation is anything that can be taken in through the senses. This would be things that you see, hear, taste, smell, touch, or taste. An inference is a statement that explains the observations.

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter "O" for an observation, or the letter "I" for an inference.

1. \_\_\_I\_\_\_ It is summertime.
2. \_\_\_O\_\_\_ It is day time.
3. \_\_\_O\_\_\_ They saw birds.
4. \_\_\_I\_\_\_ They saw seagulls.
5. \_\_\_I\_\_\_ They went swimming.
6. \_\_\_I\_\_\_ One friend's name was Bob.
7. \_\_\_O\_\_\_ It was a warm day.
8. \_\_\_O\_\_\_ The birds were black and white.
9. \_\_\_I\_\_\_ They ate lunch and drank Coke.
10. \_\_\_I/O\_\_\_ The people are friends.

**Canon Paleo Curriculum**  
**Unit: Nature of Science**  
**Lesson Plan: 9**

**Activity Name: Qualitative Vs. Quantitative**

**Supplies:**

Qualitative Vs. Quantitative Worksheet

**Preparation:**

Copy worksheet for students

Review definitions of qualitative and quantitative

**Concept:**

Students learn to distinguish between qualitative and quantitative. Later they will be apply these ideas to their hypothesis.

**Activity:**

Have students fill out worksheet

Review answers

**Conclusions:**

Students begin to discern between measurable data and subjective data.

**Time:** 20-25 Minutes

## QUALITATIVE VS. QUANTITATIVE WORK SHEET

All of the observations in this worksheet were qualitative; that is, you observed a quality about an object (it smelled good, it was green, etc.). Another type of observation is quantitative, meaning that it can be described or measured in concrete numerical terms. The following observations are quantitative:

There are 30 students in my class. I weigh 98 pounds. 1 ate a pound of potatoes.

Determine which of the following statements are quantitative and which are qualitative.

1. \_\_\_\_\_ The cup had a mass of 454 grams.
2. \_\_\_\_\_ The temperature outside is 25° C.
3. \_\_\_\_\_ It is warm outside.
4. \_\_\_\_\_ The tree is 30 feet tall.
5. \_\_\_\_\_ The building has 25 stories.
6. \_\_\_\_\_ The building is taller than the tree.
7. \_\_\_\_\_ The sidewalk is long.
8. \_\_\_\_\_ The sidewalk is 100 meters long.
9. \_\_\_\_\_ The race was over quickly.
10. \_\_\_\_\_ The race was over in 10 minutes.

## CONSTRUCTING INFERENCES FROM OBSERVATIONS

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter "O" for an observation, or the letter "I" for an inference.

1. \_\_\_\_\_ It is summertime.
2. \_\_\_\_\_ It is daytime.
3. \_\_\_\_\_ They saw birds.
4. \_\_\_\_\_ They saw seagulls.
5. \_\_\_\_\_ They went swimming.
6. \_\_\_\_\_ One friend's name was Bob.
7. \_\_\_\_\_ It was a warm day.
8. \_\_\_\_\_ The birds were black and white.
9. \_\_\_\_\_ They ate lunch and drank Coca-Cola&.
10. \_\_\_\_\_ The people are friends.

## KEY FOR TEACHER

### QUALITATIVE VS. QUANTITATIVE WORK SHEET

All of the observations in this worksheet were qualitative; that is, you observed a quality about an object (it smelled good, it was green, etc.). Another type of observation is quantitative, meaning that it can be described or measured in concrete numerical terms. The following observations are quantitative:

There are 30 students in my class. I weigh 98 pounds. 1 ate a pound of potatoes.

Determine which of the following statements are quantitative and which are qualitative.

1. Quant. The cup had a mass of 454 grams.
2. Quant. The temperature outside is 25° C.
3. Qual. It is warm outside.
4. Quant. The tree is 30 feet tall.
5. Quant. The building has 25 stories.
6. Qual. The building is taller than the tree.
7. Qual. The sidewalk is long.
8. Quant. The sidewalk is 100 meters long.
9. Qual. The race was over quickly.
10. Quant. The race was over in 10 minutes.

### CONSTRUCTING INFERENCES FROM OBSERVATIONS

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter "O" for an observation, or the letter "I" for an inference.

1. I It is summertime.
2. O It is daytime.
3. O They saw birds.
4. I They saw seagulls.
5. I They went swimming.
6. I One friend's name was Bob.
7. O It was a warm day.
8. O The birds were black and white.
9. I They ate lunch and drank Coca-Cola&.
10. I/O The people are friends.

**Canon Paleo Curriculum**  
**Unit: The Nature of Science**  
**Lesson Plan 10**  
**Qualitative/Quantitative**

**Activity Name: Cookie Lab**

**Supplies:**

3 different types of store-bought chocolate chip cookies, enough for each student  
Sheets of paper with A, B, and C written at the top.  
Scales for weighing cookies  
Ruler for measuring  
Calculators for math problems  
"Cookie Lab" handouts

**Preparation**

Having supplies ready  
Have students do "Qualitative Vs. Quantitative" and "Observation and Inference"  
Work Sheet  
Provide rulers, worksheets, calculators, and scales

**Concept:**

Students will determine which cookie is best quantitatively and qualitatively.

**Activity:**

Pass out the activity sheets  
Pass out cookies  
Have students follow the handout  
propose a hypothesis  
do qualitative and quantitative data

**Conclusions:**

Students learn to assess how these two types of data that assist researchers when they test a hypothesis.

**Time:** 1 hour to 1 ½ hour.

NAME- \_\_\_\_\_

DATE \_\_\_\_\_

PERIOD \_\_\_\_\_

## **COOKIE LAB-USING THE SCIENTIFIC METHOD**

### **INTRODUCTION:**

Often two types of data can be collected from an experiment. Quantitative data is information that can be accurately measured and recorded. Qualitative data is information that requires judgment on the part of the researcher. In this lab you will be asked to take both quantitative and qualitative data.

### **I. PROBLEM**

1. Which brand of cookie is the least expensive?
2. Which brand of cookie is the best tasting?
3. Which brand of cookie has the best appearances

### **II. FACTS**

Brand	Number of Cookies per Bag A B C	Cost
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**III. FORMING HYPOTHESIS**-Form a hypothesis about each of the problems given in Step I .

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

## IV. EXPERIMENT

Part A: Each group of three students should have nine cookies (three of each brand). Place the three cookies of each brand on a labeled sheet of paper so you will not mix them up. The members of your group should take turns weighing each cookie and recording its mass on the table labeled Part A: Quantitative Data.

Part B: Take one cookie of each brand and as a group record the qualitative data for the three brands of cookies. Rate the cookies on a scale from 1 to 3, 1 being the worst and 3 being the most desirable for each quality.

### V. RESULTS

#### Part A. Quantitative Data

Brand	Mass	Average Mass	Mass of Bag
	1    2    3		

A

B

C

#### Part B: Qualitative Data

Brand	Texture	# of chips	Crispiness	Color	Mass	Size	Taste	Total
-------	---------	------------	------------	-------	------	------	-------	-------

A

B

C

## VI. CONCLUSION

1. Now that you know the mass and cost of each bag of cookies,  
determine which brand was the least expensive.

2. Look back to your original hypotheses.

Which hypotheses are supported by your data? \_\_\_\_\_

Which hypotheses are refuted by your data? \_\_\_\_\_

3. Which brand of cookie is the best tasting? \_\_\_\_\_

4. Which brand of cookie has the best appearance? \_\_\_\_\_

5. Compare your results with other groups. Are the results alike? \_\_\_\_\_

6. Which data, qualitative or quantitative, is most consistent with the rest of the class?

\_\_\_\_\_

7. Which type of data would you expect to be most accurate? Why? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## **COOKIE LAB – Key for Teachers**

This lab will vary from group to groups. After lab is complete have class come back together as a group and develop the data collected for the best conclusion. Grades should be based on thorough collection of data and the conclusions reached by individual groups.

## General Biology Unit Exam

Name \_\_\_\_\_

Date \_\_\_\_\_

Period \_\_\_\_\_

Write the letter of the term or phrase that correctly completes the statement.

- \_\_\_\_\_ 1. The recorded measurements taken during an experiment are:  
(a) conclusions (b) data (c) variables (d) controls.
- \_\_\_\_\_ 2. A statement that explains an observations is called the  
(a) experiment (b) observation (c) variable (d) hypothesis
- \_\_\_\_\_ 3. Changes that occur during an experiment are compared with an unchanged group called the:  
(a) variable (b) control (c) hypothesis (d) conclusion
- \_\_\_\_\_ 4. Testing the hypothesis is called:  
(a) a conclusion (b) an experiment (c) a theory (d) a law
- \_\_\_\_\_ 5. At the end of an experiment, a scientist forms a(n):  
(a) problem (b) hypothesis (c) observation (d) conclusion

Each sentence below describes a step of the scientific method. Match each sentence with a step of the scientific method listed below.

- A. recognize a problem  
B. form a hypothesis  
C. test the hypothesis with an experiment  
D. draw conclusions

- \_\_\_\_\_ 6. Grant wondered if dyes could be taken out of leaves, flowers, and stems of plants.
- \_\_\_\_\_ 7. Tiffney soaked six different kinds of seeds in water for 24 hours. Then she planted the seeds in soil at a depth of 1 cm. She used the same amount of water, light, and heat for each kind of seed.
- \_\_\_\_\_ 8. Ty read about growing plants in water. He wanted to know how plants could grow without soil
- \_\_\_\_\_ 9. Angela said, "If I grow five seedlings in red light, I think the plants will grow faster than the five plants grown in white light."
- \_\_\_\_\_ 10. Doug fed different diets to three groups of guinea pigs. His experiment showed that guinea pigs need vitamin C and protein in their diets.

## General Biology Unit Exam -- KEY FOR TEACHERS

Name \_\_\_\_\_

Date \_\_\_\_\_

Period \_\_\_\_\_

Write the letter of the term or phrase that correctly completes the statement.

- B   1. The recorded measurements taken during an experiment are:  
(a) conclusions (b) data (c) variables (d) controls.
- D   2. A statement that explains an observations is called the  
(a) experiment (b) observation (c) variable (d) hypothesis
- B   3. Changes that occur during an experiment are compared with an  
unchanged group called the:  
(a) variable (b) control (c) hypothesis (d) conclusion
- B   4. Testing the hypothesis is called:  
(a) a conclusion (b) an experiment (c) a theory (d) a law
- D   5. At the end of an experiment, a scientist forms a(n):  
(a) problem (b) hypothesis (c) observation (d) conclusion

Each sentence below describes a step of the scientific method. Match each sentence with a step of the scientific method listed below.

- A. recognize a problem
- B. form a hypothesis
- C. test the hypothesis with an experiment
- D. draw conclusions

- A   6. Grant wondered if dyes could be taken out of leaves, flowers, and stems of plants.
- C   7. Tiffney soaked six different kinds of seeds in water for 24 hours. Then she planted the seeds in soil at a depth of 1 cm. She used the same amount of water, light, and heat for each kind of seed.
- A   8. Ty read about growing plants in water. He wanted to know how plants could grow without soil
- B   9. Angela said, "If I grow five seedlings in red light, I think the plants will grow faster than the five plants grown in white light."
- D   10. Doug fed different diets to three groups of guinea pigs. His experiment showed that guinea pigs need vitamin C and protein in their diets.